PATENT SPECIFICATION

828,336

NO DRAWINGS.

Inventor:—NORMAN CLIFFORD WELSH.

Date of filing Complete Specification : Nov. 13, 1957.

Application Date : Nov. 14, 1956. No. 34816/56.

Complete Specification Published : Feb. 17, 1960.

Index at Acceptance :—Classes 72, B1B3(B : F) ; and 82(2), F(1X : 2F : 2M : 2Z5 : 4K).

International Classification :— G21d. C23c.

COMPLETE SPECIFICATION.

Improvements in and relating to Metal Surfaces.

We, ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, a British Company, having its registered office at Crown House, Aldwych, London, W.C.2, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to methods of treating electrically conducting surfaces in order to improve surface quality, such as hardness, resistance to wear, heat or corrosion. To this end it has already been suggested to apply under heat additional material to the surface so that the additional material may adhere to or diffuse into the surface and may combine or alloy with the original surface material, using electric sparking for the production of the heat required in this process, whereby the electrical forces may also assist to move the particles of the additional material towards the surface to be treated.

It will be understood that in general, and in particular for the purpose of this Specification, the term "electro-sparking" is meant to indicate a plurality of discharges of electric energy of very short duration occurring simultaneously with each other and also in succession between an electrode and the conductive surface to be treated which forms the other electrode, the sparks being produced in a medium which may be liquid or if gaseous is of atmospheric pressure so that no gas-tight housing is necessary, as distinct from gaseous conduction discharge which is a continuous glow discharge maintained in a gas or vapour of sub-atmospheric pressure and necessitates a gas-tight enclosure or housing. If direct current is used to supply the sparking energy, the surface to be treated is made negative, in contrast to cathode sputtering where the surface to be treated is positive and the electrode is negative. In the sparking process using d.c. energy the electric field between the electrodes assists the particle movement towards the surface to be treated. However, results which are substantially similar to d.c. sparking can be obtained with a.c. sparking as the body forming the surface to be treated provides for greater heat dissipation and remains cooler than the electrode, therefore more particles are transferred in the direction towards the surface to be treated.

It will also be understood that the instantaneous spark discharges provide short time intermittent and localised bursts of heating with high temperatures restricted to very limited discharge areas, during discharge periods which are separated by non-heating periods so that the surface areas adjacent to the treated area and the interior of the body are not subjected to undesirable overheating, and cannot suffer distortion that may be caused by other conventional heating methods where the actual heating is not locally restricted to minute zones and is more continuous in time.

The electric sparks can be produced by a means known in the art using for instance repeated capacitor discharges, electrodes which vibrate to change the distance separating them from the work surface, or by potential changes which may be derived for instance from a high frequency source and may be superimposed upon a d.c. or low a.c. potential.

The invention aims at an improvement which facilitates carrying out the surface treatment by electro-sparking of the kind described and widens the range of material

[*Price* 3*s*. 6*d*.]

Price 4s 6d.

which can be applied as additional material to the surface to be improved, by using such material in powder form. Thus the amount of additional material which arrives at the surface to be treated can be readily controlled, and material which cannot be produced easily in rod form, or does not possess sufficient electrical conductivity to serve itself for the electrode can be used.

Accordingly this invention resides in a method of treating an electrically conducting surface using an electro-sparking process as hereinbefore defined for adding one or more substances to the material of this surface, wherein one or more substances to be added are in powder form.

The powder may be carried by a gas supplied to the sparking zone, or by a liquid in which the sparking occurs, or be included in a paste applied to the sparking electrode, or to the work surface, or both. Alternatively the powder may form part of a sparking electrode which is consumed in the sparking process. Such an electrode may comprise a rod of metal-graphite compact or a tube containing the powder. The gas or liquid or paste basis carrying the powder may be selected to promote desired reactions or inhibit undesirable reactions, or both, in the sparking zone.

The method according to the present invention may cause deposition upon or inclusion in the surface of the workpiece of the additional substance. A chemical reaction may occur between the additional and surface materials. The two materials may form a solid solution or an alloy. The gas or liquid or paste basis abovementioned and at least a portion of the material in an electrode, which may be compacted, or of tube shape, can contribute to the effect which is mainly caused by the additional material of powder form.

The powder used in accordance with the invention may comprise for example chromium, tungsten, tantalum or another high melting point metal or a mixture thereof. If the sparking is carried out with a graphite electrode such metal powder is carburised and a carbide surface is formed on the work-piece, the material of which may be a ferrous or a non-ferrous metal or an alloy.

If the powder is dispersed in a carbonaceous carrier such as a wax, grease, or mineral oil, the carbon contents of the carrier can effect the carburisation or contribute to it.

In a particular embodiment, for instance, the work-piece is of steel and the purpose of the treatment according to this invention is to increase its hardness and wear resistance by carbide formation on its surface.

It will be understood, however, that modifications are possible without departing from the scope of the present invention, as defined by the appended claims.

It will also be understood that apparatus known *per se* for producing suitable electro-sparking can be used. Such apparatus, as described in Specification 749,486 employing a capacitor and vibrating electrode has been found very suitable for carrying out the present invention, since the electrode can be adapted to serve for this invention and the powder material may be sprinkled onto the surface or carried in a fluid to the sparking zone.

WHAT WE CLAIM IS:—

1. Method of treating an electrically conducting surface using an electro-sparking process as hereinbefore defined for adding one or more substances to the material of this surface, wherein one or more substances to be added are in powder form.

2. Method as claimed in Claim 1, wherein the powder is suspended in a gas supplied to the sparking zone.

3. Method as claimed in Claim 1, wherein the powder is suspended in a liquid in which the sparking occurs.

4. Method as claimed in Claim 1, wherein the powder is carried in a paste applied to the sparking electrode or to the work surface, or both.

5. Method as claimed in Claim 1, wherein the powder forms part of the sparking electrode.

6. Method as claimed in Claim 5, wherein the sparking electrode comprises a rod made of a metal graphite compact.

7. Method as claimed in Claim 5, wherein the sparking electrode comprises a tube containing the powder.

8. Method as claimed in Claim 1, wherein the substance or substances to be added comprise chromium, tungsten, tantalum or another high melting point metal, or a mixture of these metals.

9. Method as claimed in Claim 1, wherein the sparking electrode is made of graphite and at least one of the substances to be added is such as to combine chemically with the carbon.

10. Method as claimed in Claim 1, wherein the powder is dispersed in a carbonaceous carrier, such as a wax, grease or mineral oil.

11. Method as claimed in Claim 9, or Claim 10, wherein the work-piece is made of steel and the added substance or substances serve to form a hard carbide layer on the surface of the work-piece.

12. Method as claimed in Claim 1, and substantially as hereinbefore described.

J. W. RIDDING,
Chartered Patent Agent,
Crown House, Aldwych, London, W.C.2.
Agent for the Applicants.

PROVISIONAL SPECIFICATION.

Improvements in and relating to Metal Surfaces.

We, ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, a British Company, having its registered office at Crown House, Aldwych, London, W.C.2, do hereby declare this invention to be described in the following statement:—

We have previously described a method of improving a ferrous metal surface wherein an electric spark discharge is produced between the surface and an electrode, the spark being discharged through a liquid in which said surface is immersed, and the liquid or the electrode or both being so selected that a substance or substances transferred to said surface by the sparking either alone or in combination with the material of said body produce the required surface.

Also we have previously described a method of treating non-ferrous bodies to obtain a desired surface character, such as greater hardness or chemical resistance, wherein an electric spark discharge is produced between the surface of the article and an electrode, the electrode, or the material in which the sparking occurs, or both being selected so that one or more substances transferred by the sparking therefrom to the said surface change its character.

Further investigations have shown that the metal surface of a work-piece can be improved by electro-sparking if one or more substances required for such improvement are present in or supplied to the sparking zone in powder form.

In this manner it is possible to obtain surface improvements, such as greater hardness and wear resistance, or higher heat resistance, by means of substances which are not readily available in rod form, or do not possess sufficient electric conductivity to serve as electrodes in an electro-sparking process.

Accordingly this invention generally resides in a method of treating the surface of a work-piece by adding through electro-sparking one or more substances to the material at this surface wherein the said substances are present in or supplied to the sparking zone in powder form.

The powder may be carried in a gas, or liquid, or a paste, or a solid, and in the latter case the powder may form part of a sparking electrode such as a rod of metal-graphite compact. The carrier material may be selected to promote desired reactions or inhibit undesirable reactions, or both.

The substantial improvement obtained with the process of electro-sparking according to the present invention may be due to deposition upon or the inclusion in the surface of the work-piece of the powder material, or to a chemical reaction between the powder material and the material of the work-piece, or both, while other substances such as the materials of the carrier of the powder or of an electrode body may also contribute to the effect.

The powder used in accordance with the invention may comprise for example chromium, tungsten, tantalum and similar high melting point metals. If the sparking is carried out with a graphite electrode such metal powder is carbonised and a carbide surface is formed on the work-piece, the material of which may be a ferrous or a non-ferrous metal, or an alloy.

If the powder is dispersed in a carbonaceous carrier, such as a wax, grease or mineral oil, the carbon contents of the carrier can effect the carburisation or contribute to it.

In a particular embodiment, for instance, the work-piece is of steel and the purpose of the treatment according to this invention is to increase its hardness and wear resistance by carbide formation on its surface.

It will be understood, however, that modifications are possible without departing from the general scope of the present invention.

J. W. RIDDING,
Chartered Patent Agent,
64–66 Coleman Street,
London, E.C.2,
Agent for the Applicants.

Abingdon: Printed for Her Majesty's Stationery Office, by Burgess & Son (Abingdon), Ltd.—1960.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2,
from which copies may be obtained.